

WHAT IS CLAIMED IS:

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1. An aberration changing optical system for changing an aberration, characterized by an optical element having at least one of a cylindrical surface and a toric surface and being rotatable about and tiltable to an optical axis of said optical system.

2. An aberration changing optical system for changing an aberration, characterized by an optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, said optical element being rotatable about and tiltable to an optical axis of said optical system.

3. An aberration changing optical system according to Claim 1 or 2, wherein there are a plurality of optical elements each being as aforesaid, and wherein said optical elements are selectively used.

4. An aberration changing optical system according to Claim 1 or 2, further characterized by a second optical element having at least one of a cylindrical surface and a toric surface and being rotatable about and tiltable to the optical axis of said optical system integrally with the first-

mentioned optical element, said second optical element further being tiltable in an opposite direction to the first-mentioned optical element.

5 5. An aberration changing optical system according to Claim 1 or 2, further characterized by a parallel flat plate being rotatable about and tiltable to said optical axis of said optical system integrally with the optical element, said parallel flat plate
10 further being tiltable in an opposite direction to said optical element.

6. An aberration changing optical system according to any one of Claims 1 - ²4, wherein said
15 optical element is mainly composed of a transparent material of one of quartz and fluorite.

a 7. An aberration changing optical system according to any one of Claims 1 - ²4, wherein the or
20 each surface of said optical element, having a refracting power, has a refractive power not greater than $3 \times 10^{-7} \text{ mm}^{-1}$.

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a 8. A projection system, comprising:
a projection optical system: and
an aberration changing optical system as recited in any one of Claims 1 - ²4, for correcting an

aberration to be produced in said projection optical system.

5 9. A projection exposure apparatus, comprising:
an illumination system; and
a projection system for projecting a pattern
of a mask onto a substrate in cooperation with said
illumination system, said projection system including
a projection optical system and an aberration changing
10 optical system, as recited in any one of Claims 1 - ²7.
for correcting an aberration to be produced in said
projection optical system.

15 10. A device manufacturing method, including a
process for transferring a device pattern onto a wafer
by use of a projection exposure apparatus as recited
in Claim 9.

20 11. An optical system characterized by an optical
element having at least one of a cylindrical surface
and a toric surface and being inclined with respect to
an optical axis.

25 12. An optical system characterized by an optical
element having different refracting powers in two
orthogonal directions or having a refracting power
only in one direction, said optical element being

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inclined with respect to an optic 1 axis.

13. An optical system according to Claim 11 or 12, wherein there are a plurality of optical elements each being as aforesaid, and wherein said optical elements are selectively used.

14. An optical system according to Claim 11 or 12, further characterized by a second optical element having at least one of a cylindrical surface and a toric surface and being inclined with respect to the optical axis and in an opposite direction to the first-mentioned optical element.

15. An optical system according to Claim 11 or 12, further characterized by a parallel flat plate being inclined with respect to the optical axis and in an opposite direction to said optical element.

16. An optical system according to any one of Claims 11 - ¹²15, wherein said optical element is mainly composed of a transparent material or one of quartz and fluorite.

17. An optical system according to any one of Claims 11 - ¹²15, wherein the or each surface of said optical element, having a refracting power, has a

refractive power not greater than $3 \times 10^{-7} \text{mm}^{-1}$.

18. A projection system, comprising:
a projection optical system; and
5 an optical system as recited in any one of
Claims 11 - ¹²17, for correcting an aberration to be
produced in said projection optical system.

19. A projection exposure apparatus, comprising:
10 an illumination system; and
a projection system for projecting a pattern
of a mask onto a substrate in cooperation with said
illumination system, said projection system including
a projection optical system and an optical system, as
15 recited in any one of Claims 11 - ¹²17, for correcting
an aberration to be produced in said projection
optical system.

20. A device manufacturing method, including a
20 process for transferring a device pattern onto a wafer
by use of a projection exposure apparatus as recited
in Claim 19.